



Socioeconomic factors associated with the burden of chronic filariasis as a neglected tropical disease in West Java (2019–2023)

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Received Date: January 21, 2026

Revised Date: May 25, 2026

Accepted Date: July 15, 2026

ABSTRACT

Background: Filariasis is one of the major Neglected Tropical Diseases (NTDs) and remains a public health problem in Indonesia, with West Java ranked among the highest burden provinces. However, evidence on how socioeconomic conditions influence Filariasis distribution at the sub-provincial level is still limited. **Methods:** An ecological panel study was conducted at the district/city level in West Java from 2019 to 2023. Annual chronic filariasis prevalence per 100,000 population was visualized using heatmaps and summarized through temporal and spatial coefficients of variation (CV). Socioeconomic factors, including mean years of schooling, poverty depth index, poverty rate, sanitation and safe water access, health worker ratio, population growth, and population density, were analyzed through Spearman bivariate correlation tests and further examined using a pooled log-linear ordinary least squares (OLS) regression model with year fixed effects and cluster robust standard errors at the district level. **Findings:** The heatmap revealed persistent spatial disparities, with Sukabumi District consistently exhibiting the highest prevalence. Temporal analysis showed that inter-regional variation decreased substantially, with spatial CV declining from 1.41 in 2019 to 0.55 in 2023, suggesting increasing convergence across districts. Spearman analysis identified significant associations with population growth (p-value = 0.323), poverty depth index (p-value = 0.286), poverty rate (p-value = 0.264), mean years of schooling (p-value = -0.259), and population density (p-value = -0.239). Multivariate log-linear OLS model confirmed population growth as the strongest independent predictor of filariasis prevalence and mean years of schooling remained a significant protective factor associated with reduced disease burden. **Conclusion:** Filariasis prevalence in West Java became more evenly distributed between 2019 and 2023, although several high-burden districts persist. The findings further indicate that demographic and educational disparities remain key socioeconomic determinants of disease risk, underscoring the importance of integrated control strategies that address rapid population growth while improving access to education. **Novelty/Originality of this article:** This study provides integration of descriptive spatial temporal and socioeconomic analyses to explain the persistent disparities in filariasis prevalence across districts in West Java, Indonesia.

KEYWORDS: filariasis; neglected tropical diseases; socioeconomic factor.

1. Introduction

Neglected tropical diseases (NTDs) are a group of chronic infectious diseases caused by parasitic, viral, and bacterial pathogens that primarily affect populations in low- and middle-income countries (Magalhães et al., 2023). They are referred to as “neglected”

Cite This Article:

Alfiani, R., & Kosen, Y. D. (2026). Socioeconomic factors associated with the burden of chronic filariasis as a neglected tropical disease in West Java (2019–2023). *Journal of Evidence-based Nursing and Public Health*, 3(2), 201-218. <https://doi.org/10.61511/jevnah.v3i2.2026.3281>

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because they receive far less global funding, research attention, and policy priority than higher profile infectious diseases such as HIV/AIDS, malaria, and tuberculosis (Ca et al., 2024).

Although they are referred to as “neglected,” the World Health Organization (WHO) has recognized more than 20 of these diseases, including filariasis, schistosomiasis, trachoma, and leprosy (Ferreira et al., 2022). According to WHO (2023), over 1.6 billion people remain at risk of acquiring at least one NTDs and more than 170,000 deaths occur annually. Southeast Asia is among the most heavily affected regions, where a combination of climatic, environmental, and socioeconomic factors creates ideal conditions for transmission. Nearly 200 million people live in the region with extreme poverty and many are infected with at least one NTD, particularly in countries such as Indonesia, Philippines, Myanmar, Vietnam, and Cambodia (Sripa et al., 2022).

Within the broader group of NTDs, Filariasis is among the most prevalent and disabling diseases. More than 120 million people across 72 tropical and subtropical countries are infected with the filarial nematodes *Wuchereria bancrofti*, *Brugia malayi*, and *Brugia timori*, transmitted through the bites of female mosquitoes from genera such as *Culex*, *Anopheles*, *Mansonia*, and *Aedes* (Bhuvaneswari et al., 2023). After infection, adult worms inhabit and reproduce within the lymphatic system, causing obstructive pathology that leads to chronic lymphedema, elephantiasis, and hydrocoele, with profound consequences for physical impairment, productivity loss, social stigma, and severe psychological distress (Bhuvaneswari et al., 2023; Roswati et al., 2021; Vasconez-Gonzalez et al., 2025).

Acknowledging the global burden of filariasis, WHO launched the global programme to eliminate lymphatic filariasis (GPELF) under World Health Assembly Resolution WHA 50.29 (1997). The GPELF's strategy is built upon two pillars, the interruption of transmission through annual mass drug administration (MDA) and morbidity management and disability prevention strategies (MMDP) (Chiphwanya et al., 2024; Douglass, 2025). Nevertheless, the achievement of these elimination targets varies across countries. This variation occurs because the success of elimination depends not only on medical interventions but also on the strength of health systems, the consistency of policy support, and the effectiveness of program implementation at the national and local levels. Several studies have also demonstrated that socioeconomic factors, such as poverty, education, sanitation, population density, and access to healthcare play a critical role in the transmission and persistence of various NTDs (Abou-El-Naga, 2015; Branda et al., 2024; Dowling et al., 2013; Magalhães et al., 2023). Recent evidence further emphasizes that these determinants act as structural barriers that disproportionately affect marginalized urban populations, often leading to persistent transmission hotspots (Akogun et al., 2025; Chaturvedi & Sharma, 2025). Furthermore, disability-adjusted life years and disease prevalence data underscore that socioeconomic inequalities remain the primary driver for the sustained burden of filariasis, even in regions with long-standing elimination programs (Zhao et al., 2025). These factors influence human-vector contact patterns, environmental suitability for mosquito breeding, health-seeking behavior, and the effectiveness of MDA implementation. As a result, regions characterized by socioeconomic inequality often exhibit heterogeneous patterns of filariasis even within the same province or country.

These dynamics are also reflected In Indonesia, where filariasis remains a major public health concern and ranks among the most widespread NTDs in Southeast Asia. Although Indonesia adopted WHO's elimination strategy and has implemented MDA in endemic areas since 2002, the country still reported approximately 10,000–11,000 confirmed cases in recent years. Among these cases, West Java is one of the most affected provinces, ranking sixth nationally in the number of chronic cases after Aceh and Central Papua (Aisyah et al., 2022; Ministry of Health, 2023b). Critically, prevalence continues to vary widely between districts, suggesting the influence of economic, social, and environmental inequalities.

Although studies on socioeconomic disparities in health have grown extensively, studies specifically examining the socioeconomic determinants of filariasis prevalence in West Java remain limited. Crucially, a deeper understanding of how socioeconomic

indicators shape the distribution of the disease is essential for identifying high-risk areas and designing more targeted elimination strategies (Houweling et al., 2016).

Therefore, to address this gap, the present study analyzes the relationship between socioeconomic factors and filariasis prevalence in West Java Province during 2019–2023. Through descriptive spatial assessment and panel regression modelling, the study seeks to characterize the socioeconomic factors underlying inter-district heterogeneity in chronic filariasis burden. By pinpointing exact high-risk zones and their socioeconomic drivers, this evidence could provide actionable data for both broad community-based public health programs and specific nursing practices. Ultimately, this integration enables policymakers, healthcare providers, and local communities to transition from generalized mass campaigns to tailored, localized interventions that effectively address health inequities.

2. Methods

This study employed an ecological panel design at the district/city level (corresponding to *Kabupaten/Kota* in the Indonesian administrative system) in West Java Province for the 2019–2023 period. An ecological approach was appropriate because all variables were aggregated at the area level and did not involve individual-level information. Secondary data were obtained from the Central Bureau of Statistics/*Badan Pusat Statistik* (BPS) (<https://bps.go.id>) and West Java Open Data (*Open Data Jabar*) (<https://opendata.jabarprov.go.id>) (N = 27 regions; T = 5 years).

The dependent variable was the annual prevalence of chronic filariasis per 100,000 population, calculated by dividing the number of reported chronic cases by the total population in each district/city and year. Independent variables consisted of key socioeconomic indicators, including mean years of schooling, access to improved sanitation, access to improved drinking water, health worker ratio (per 10,000 population), population growth rate, population density, poverty rate, and poverty depth index. These indicators were selected based on established frameworks of the social determinants of health and supported by previous empirical evidence linking them to disease transmission dynamics.

Spatial and temporal patterns of filariasis were examined descriptively using heatmap visualization to illustrate annual prevalence across districts/cities. This visualization facilitated the identification of districts with consistently high prevalence and revealed year-to-year fluctuations in spatial patterns throughout the study period. Temporal stability and spatial disparity were further assessed using the coefficient of variation (CV). For each district or city, temporal CV was calculated across years (2019–2023) to determine whether local prevalence trends were stable or fluctuating over time, while annual spatial CV was calculated to quantify inter-regional disparities in prevalence within each study year, providing insight into the extent of inequality in the geographic distribution of filariasis (Shechtman, 2013). Importantly, these analyses were exploratory and descriptive in nature and were not intended to evaluate spatial dependence. Therefore, no spatial inferential methods such as Moran's I or LISA were applied.

Descriptive statistics were used to summarize the distribution of all variables, including measures of central tendency and dispersion (mean, median, standard deviation, minimum, and maximum). Differences in filariasis prevalence across districts/cities were tested using the Kruskal–Wallis H test due to the non-normal and zero-inflated nature of the dependent variable. When the overall test indicated significant differences ($p < 0.05$), post-hoc pairwise comparisons were conducted using Dunn's test with Benjamini–Hochberg correction to identify specific district pairs exhibiting statistically significant disparities in prevalence (adjusted $p < 0.05$).

Bivariate associations between filariasis prevalence and socioeconomic predictors were examined using Spearman's rank correlation ($p < 0.005$) (Williams et al., 2023). Subsequently, multivariable regression analysis was conducted using a log-linear Ordinary Least Squares (OLS) model to evaluate whether the observed associations persisted after accounting for intercorrelation among predictors. In this analysis, the dependent variable was transformed as $\log(\text{prevalence} + 0.01)$ to accommodate zero values and improve

distributional properties. A pooled panel specification with year fixed effects was applied to adjust for unobserved time specific influences such as changes in national policy or public health interventions. Standard errors were clustered by district/city to account for intra-regional correlation over time, yielding more conservative and reliable significance tests. Regression results are presented as coefficients (β), standard errors (SE), and p-values, with effects expressed as percentage changes in prevalence for a one-unit increase in each predictor.

Prior to model estimation, multicollinearity among predictors was evaluated using the variance inflation factor (VIF). All VIF values ranged from 1.27 to 7.67, well below the conventional threshold of 10, indicating no problematic collinearity (Kwarteng et al., 2021). Therefore, all predictors were retained in the final model. All data preparation, visualization, and statistical analyses were conducted in R (version 4.2) using established analytical packages and standard statistical workflows.

3. Results and Discussion

3.1 Distribution and temporal variation of filariasis prevalence in West Java

The heatmap visualization reveals pronounced spatial disparities in the prevalence of chronic filariasis across West Java during the 2019–2023 period (Figure 1). A small number of districts, most notably Kabupaten Sukabumi, consistently exhibited the highest prevalence values each year, forming a clear upper outlier relative to the rest of the province. Kota Sukabumi and Kota Cirebon also appeared as recurrent high-burden areas, although both displayed a modest decline in prevalence by 2022–2023. In contrast, the majority of districts and cities reported persistently low or zero prevalence, producing a distinct divide between a concentrated cluster of high-burden regions and a large group of districts where chronic cases were largely absent.

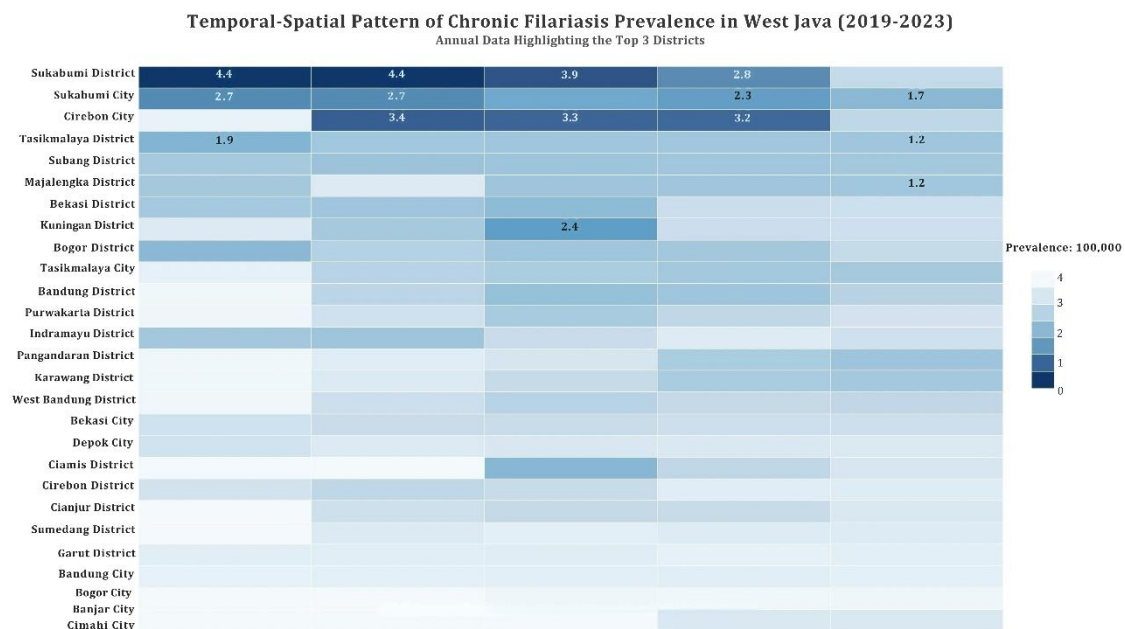


Fig. 1. Chronic filariasis prevalence per 100,000 population by districts/cities and year in West Java (2019–2023), annotated with the Top-3 districts each year

Beyond spatial variation, the temporal dimension of the heatmap highlights that the high-burden districts maintained their elevated prevalence levels for several consecutive years. This stability suggests that chronic filariasis burden in these areas is not driven by short-term fluctuations but reflects long-standing endemicity and historical transmission

intensity that continues to manifest as chronic morbidity. Meanwhile, districts with near-zero prevalence remained consistently low across all five years.

The results of the post-hoc Dunn test further substantiate the observed spatial disparities, confirming that differences between high and low prevalence areas are statistically significant. For this analysis, only the 15 most significant pairwise comparisons were retained, sorted by the smallest adjusted p-values. All of the strongest contrasts involved kabupaten Sukabumi, the consistently highest prevalence area, when compared with low prevalence urban districts such as kota Cimahi, kota Banjar, kota Bandung, and kota Bogor. For instance, the comparison between Sukabumi District and Cimahi City ($Z = 4.53$; $p_{\text{adj}} < 0.005$), as well as those involving Banjar, Bandung, and Bogor ($Z \approx 4.0$; $p_{\text{adj}} < 0.005$), indicates that the median prevalence in Sukabumi is significantly higher than in these cities. A similar pattern is observed in kabupaten Tasikmalaya, which also shows a significant difference when compared with Cimahi City ($Z \approx 4.1$; $p_{\text{adj}} < 0.005$). This suggests that certain districts located in the southern part of the province have formed a persistent high-risk cluster, whereas most urban centers remain largely disease free.

Overall, the combination of the heatmap and Dunn's test indicates that spatial disparities in chronic prevalence are persistent, particularly from 2019 to 2022, with a few districts becoming hotspots that are significantly different from the majority of other districts/cities that are nearly case free. The widespread presence of zero values or casefree in most districts may reflect true elimination of chronic morbidity or low detection of late manifestations. However, the repeated absence of cases across multiple consecutive years supports the interpretation that chronic filariasis in West Java has become geographically concentrated rather than under-reported province-wide.

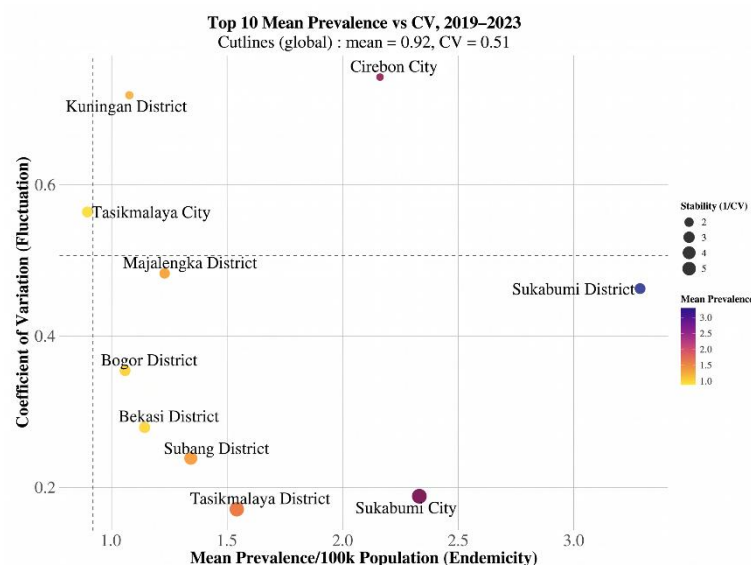


Fig. 2. Mean prevalence and temporal variability (coefficient of variation, CV) of chronic filariasis across districts/cities in West Java, 2019–2023. Higher mean values indicate greater endemicity, while lower CV values indicate temporal stability within each district

Further analysis utilizing the temporal coefficient of variation (CV) clarifies the prevalence dynamics in each region in Figure 2. Sukabumi District, which consistently appears as the highest prevalence area in the heatmap, also occupies the far right position on the CV plot, with a mean prevalence of approximately 3.29 per 100,000 and a CV of 0.46. This combination indicates not only a high level of endemicity, but also relatively strong temporal stability, meaning that prevalence values remain consistently high from year to year, thereby forming a persistent chronic endemic pattern. In contrast, kota Cirebon exhibited a low mean prevalence but a considerably higher temporal CV (0.76), indicating that its case counts fluctuated more sharply year-to-year.

Moreover, the temporal CV suggests that transmission patterns in other districts and cities across West Java remain sporadic, implying that control efforts have not yet achieved full stabilization. Although the mean prevalence is relatively low across the province, the observed moderate to high CV values indicate that sudden increases in case numbers may still occur in specific years. Such temporal instability likely reflects the influence of shifting environmental and socioeconomic conditions, including year-to-year variations in sanitation access, population mobility, and the intensity of public health interventions.

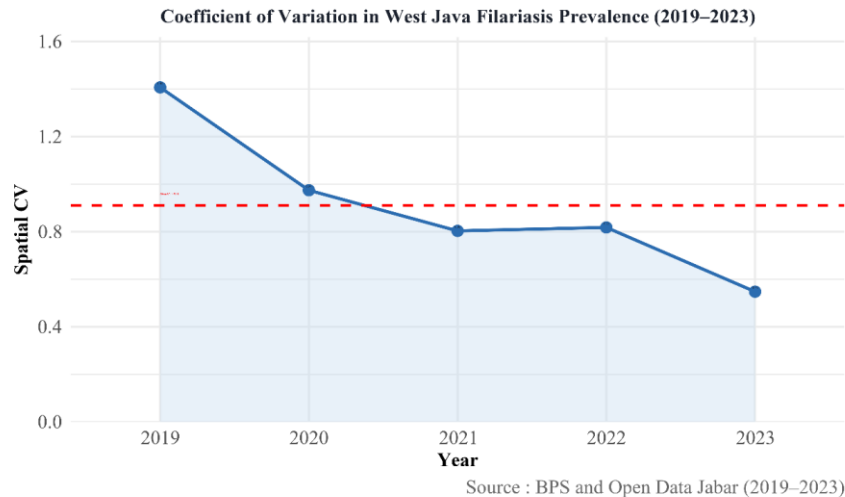


Fig. 3. Yearly spatial coefficient of variation (CV) of chronic filariasis prevalence across districts/cities in West Java, 2019–2023

The annual spatial coefficient of variation (CV) provides additional insight into the extent of geographical inequality in chronic filariasis prevalence across districts and cities in West Java (Figure 3). A clear downward trend is observed from 2019 to 2023, indicating a progressive reduction in inter-regional disparity over time. At the beginning of the study period in 2019, the CV reached its highest value (1.41), suggesting substantial heterogeneity where a small number of districts exhibited disproportionately higher prevalence levels compared with the rest of the province. This pattern is consistent with the heatmap findings (Fig. 1), where darker concentrations in districts such as Kabupaten Sukabumi and Kota Cirebon indicated localized hotspots of chronic morbidity. However, after 2020, the CV value gradually decreased, reaching 0.55 in 2023. This decline indicates a narrowing of differences between regions in prevalence rates, reflecting a trend toward spatial convergence or homogenization among districts/cities.

This general pattern of narrowing disparity may reflect the cumulative impact of long-term filariasis control measures. Indonesia has implemented mass drug administration (MDA) in endemic districts for more than a decade, and since 2019, several regions have intensified their transition toward triple-drug therapy (Ivermectin, Diethylcarbamazine, Albendazole/IDA) following updated WHO recommendations (Ministry of Health, 2023a; Tripathi et al., 2022). Although chronic filariasis represents morbidity from historical infections rather than new transmission, improved preventive measures may gradually reduce the reservoir of chronic cases, thereby contributing to decreasing heterogeneity between regions. Furthermore, following the implementation of the national policy targeting filariasis elimination by 2030, many districts and cities in West Java have strengthened active surveillance, public health education, and cross-sectoral collaboration in environmental management.

However, this convergence at the provincial scale does not imply the disappearance of high-burden areas. Persistent clusters remain evident, particularly in Kabupaten Sukabumi and several neighboring districts continue to report chronic cases. Thus, while overall spatial disparity has diminished, inequality has not been fully eliminated. These persistent

hotspots highlight the need for targeted interventions and continued surveillance in historically endemic districts that maintain residual morbidity burdens.

It is also notable that the decline in spatial CV aligns with population-scale disruptions caused by the COVID-19 pandemic. During 2020–2021, many districts redirected financial, logistical, and human resources toward pandemic response efforts, resulting in substantial reductions in routine NTD surveillance and control activities (Butala et al., 2024). This reallocation likely slowed new case detection in historically high-burden areas while simultaneously reducing nonessential health service activities in low-burden regions. These disruptions were especially pronounced in low- and middle-income countries, where health systems were already overstretched. Consequently, the more uniform reporting landscape across districts likely reflects an artifact of universal program deprioritization rather than a true biological equalization of disease burden (Jaworski et al., 2024; WHO, 2022).

3.2 Socio-economic factor determinants of filariasis

Descriptive statistics results indicate that the mean prevalence of chronic filariasis in West Java during 2019–2023 was 0.92 cases per 100,000 population (SD = 0.88), ranging from 0 to 4.42 cases. The median of 0.71 suggests that most districts and cities exhibited relatively low endemicity, while the wide range indicates substantial spatial variation between regions (Table 1). These findings are consistent with the spatial patterns observed in the heatmap (Fig. 1), where only a small number of districts exhibited persistent cases while the majority remained near zero.

Table 1. Descriptive statistics of filariasis prevalence and socio-economic factors

Variable	Mean $\pm$ SD	Median	Min	Max
Prevalence (/100k)	0.921 $\pm$ 0.88	0.71	0	4.42
Population growth (%)	1.221 $\pm$ 0.54	1.19	0.20	3.95
Poverty depth index	0.287 $\pm$ 0.15	0.26	0.03	0.77
Poverty (%)	8.32 $\pm$ 2.76	8.41	2.07	13.13
Mean Years of schooling	8.652 $\pm$ 1.45	8.19	5.99	11.66
Population density (persons/km ²)	3823 $\pm$ 4461.40	1429	387	15421
Access to safe water (%)	93.48 $\pm$ 6.29	95.76	76.18	100
Health worker (/10k)	25.35 $\pm$ 17.97	19.25	1.99	84.27
Access to sanitation (%)	72.91 $\pm$ 16.28	76.37	34.93	98.52

Socioeconomic indicators also demonstrated marked disparities across regions. The mean years of schooling was 8.65 years (SD = 1.45), corresponding roughly to junior secondary education, but the variation suggests uneven educational attainment among districts. Similarly, poverty indicators reflected economic disparities, with an average poverty rate of 8.32% (SD = 2.76) and a poverty depth index averaging 0.287 (SD = 0.15). Access to improved sanitation averaged 72.91% (SD = 16.28), indicating that basic sanitation services remain highly unequal. By contrast, access to improved drinking water was relatively homogeneous, with an average of 93.48% (SD = 6.29), suggesting that most districts have achieved broad coverage of clean water infrastructure.

Health system capacity likewise varied considerably. The average health worker ratio was 25.35 per 10,000 population (SD = 17.97), with values ranging from 1.99 to 84.27, reflecting substantial gaps in the availability of trained personnel. Population density showed extreme heterogeneity (mean = 3,823 persons/km²; SD = 4,461), driven by the contrast between densely populated urban centers (e.g., Bandung, Bekasi) and more sparsely populated rural districts. Population growth showed similarly wide variation across districts, with an average rate of 1.22% (SD = 0.54) and values ranging from 0.20% to 3.95%. This spread indicates that while some districts experienced relatively stable populations, others underwent rapid demographic expansion, which may have important implications for disease transmission dynamics. Taken together, these descriptive patterns indicate that socioeconomic conditions in West Java are far from uniform. Substantial

variation in education, sanitation, population density, population growth, and health workforce availability may contribute to the unequal distribution of chronic filariasis across districts, providing important context for interpreting the subsequent inferential analyses.

Table 2. Spearman correlations with prevalence (per 100,000) population

Socioeconomic Factors	Spearman (ρ)	p-value
Population growth (%)	0.323	0.0001
Poverty depth index	0.286	0.0008
Poverty (%)	0.264	0.002
Mean Years of schooling	-0.259	0.003
Population density (persons/km ²)	-0.239	0.005
Access to safe water (%)	-0.127	0.142
Health worker ratio (/10k)	-0.075	0.389
Access to sanitation (%)	-0.072	0.405

The combined results of the bivariate and multivariate analyses provide a coherent picture of the socioeconomic determinants shaping the spatial distribution of chronic filariasis in West Java. Initial assessment using Spearman's rank correlation analysis identified population growth rate, poverty depth, poverty rate, mean years of schooling, and population density as significantly associated with chronic filariasis prevalence (Table 2). These findings indicate that districts characterized by rapid demographic expansion, deeper structural poverty, limited educational attainment, and denser settlement patterns tend to exhibit higher disease burdens.

Table 3. OLS log SE socioeconomic factors with prevalence per 100,000 population

Socioeconomic Factors	β (SE cluster)	p-value	Effect % (95% CI)
Mean Years of schooling	-0.455 (0.221)	0.049	-36.5% (-59.7 ; -0.2)
Poverty (%)	-0.028 (0.078)	0.725	-2.7% (-16.7 ; 13.6)
Poverty depth index	0.939 (0.830)	0.260	+155.7% (-50.6 ; 122)
Access to sanitation (%)	-0.006 (0.013)	0.621	-0.6% (-3.2 ; 2.0)
Access to safe water (%)	0.002(0.04)	0.970	0.2% (-7.7 ; 8.7)
Health worker (/10k)	0.007(0.022)	0.746	0.7% (-3.6 ; 5.3)
Population growth (%)	1.179(0.232)	< 0.001	+225% (101.8 ; 423.3)
Population density (persons/km ²)	0.027(0.127)	0.830	+2.7% (-26.8 ; 38.7)

However, when these variables were examined simultaneously in the multivariate OLS log-linear model, only population growth rate and mean years of schooling retained statistical significance (Table 3). This shift from the bivariate to multivariate results suggests that the initial correlations observed for poverty and population density were not independent and likely operate through broader structural mechanisms represented by demographic pressure and educational attainment. Population growth rate emerged as the strongest and most consistent predictor across both analytic approaches. This finding suggests that areas experiencing faster population growth tend to face a higher risk of filariasis transmission, likely due to increased residential density, greater human mobility, and more frequent human-vector contact (Chaturvedi & Sharma, 2025; Zhao et al., 2025). Increased human mobility may introduce infected individuals or parasite carrying mosquitoes into previously low risk areas, a pattern consistent with evidence from India and the Philippines, where urbanization and migration have contributed to the spread of filariasis despite ongoing MDA programs (Sharma et al., 2025).

Rapid population growth is often accompanied by unplanned settlement expansion with inadequate infrastructure, including open drainage, stagnant wastewater, and unmanaged waste. These conditions provide highly suitable breeding habitats for *Culex* spp., the predominant urban vector. In rapidly growing districts, the strain on public services, including sanitation systems, waste management, and local health service capacity, further limits the ability of authorities to conduct routine vector control and environmental monitoring. As these gaps widen, human-vector contact intensifies, increasing the

likelihood of transmission. This pattern mirrors findings from ecological studies in Bangladesh, where rapid but unregulated urban expansion was shown to sustain vector proliferation and hinder progress toward filariasis elimination (Williams et al., 2023).

The association between population growth and filariasis also reflects broader ecological processes. Rapid population growth contributes to climate change by increasing temperature and reducing vegetation humidity through the urban heat island effect. These conditions indirectly influence the *Culex spp.* life cycle and population abundance by accelerating metabolism rate, shortening the gonotrophic cycle, and extending breeding seasons (Alomar, 2025; Lupi & Marsiglio, 2021). Moreover, previous studies have reported a positive exponential relationship between the *Culex spp.* population growth rate and rising temperatures across various elevational gradients in Hawaii and the United States (Ahumada et al., 2004; Ragab et al., 2024).

This ecological shift not only increases vector abundance but also extends the transmission window of filariasis, particularly in tropical and subtropical regions where temperatures are already near optimal for vector development. Warmer conditions accelerate the reproductive cycle and survival of *Culex spp.*, enabling these vectors to thrive in environments that were previously less suitable for their development. As temperatures continue to rise, several studies have documented the expansion of *Culex* populations into higher-altitude and cooler regions, suggesting a potential widening of the geographical range of filariasis transmission (Hongoh et al., 2012; Moser et al., 2023).

Thus, this study indicates that population growth serves a dual function as both a demographic and ecological factor reinforcing the risk of filariasis transmission. Demographically, population increase expands the network of mobility and human-vector contact density, while ecologically, anthropogenic pressure from urbanization accelerates microclimatic changes that favor the mosquito vector population. Therefore, filariasis elimination efforts in densely populated areas like West Java must integrate environmental health and climate mitigation approaches into spatial planning and regional policy.

Consistent with the pattern observed for population growth, mean years of schooling demonstrated a clear and robust protective effect against chronic filariasis. It showed a strong negative correlation ($\rho = -0.259$, $p\text{-value} = 0.003$) and remained statistically significant in the multivariable regression model ($p\text{-value} = 0.049$), indicating that higher average educational attainment in a district is consistently associated with lower disease burden. This result is in line with extensive evidence showing that education is one of the most powerful social determinants of infectious disease outcomes (Houweling et al., 2016; Khalid et al., 2012; Ugbomoiko et al., 2009).

Education influences health through several interrelated mechanisms. At the individual level, higher educational attainment enhances health literacy, enabling people to understand the pathways of disease transmission, recognize environmental risk factors, and adopt effective preventive behaviors. Individuals with stronger educational backgrounds are more likely to maintain household hygiene, manage waste appropriately, prevent water stagnation around their homes, and consistently use protective measures such as bed nets or mosquito-repellent interventions. Education also improves the ability to access, interpret, and act upon health information, strengthening social communication and increasing participation in community-based prevention programs. Through these pathways, education fosters a deeper understanding of filariasis transmission dynamics, such as the role of mosquito breeding sites, insecticide resistance, and environmental sanitation, ultimately reducing exposure and interrupting transmission cycles (Raghupathi & Raghupathi, 2020; Zajacova & Lawrence, 2018).

Beyond the individual level, this relationship extends to the structural dimensions of society. Communities with lower educational attainment often experience weaker social capital, reduced economic mobility, and limited access to quality healthcare services. Over time, these disadvantages accumulate, reinforcing health disparities and intergenerational poverty. Conversely, various studies have shown that populations with higher levels of education tend to benefit from improved employment opportunities, better income stability, greater health awareness, and better access to healthcare facilities, including

preventive programs and insurance coverage, all of which contribute to stronger community resilience and reduced disease vulnerability (Kitole et al., 2024; Schudde & Bernell, 2019). Ultimately, strengthening education systems serves as a cornerstone for sustainable public health improvement, as it simultaneously enhances economic opportunity, reduces structural inequality, and builds the societal capacity needed to prevent disease and promote long term well-being (Cowell, 2006; El Tantawi et al., 2022; Goczek et al., 2021; Tsou, 2017).

Various studies have also shown a reciprocal relationship between education and health, where low levels of education are often associated with poor health due to limited income, access to resources, healthy environment, and health behaviors, while poor health can hinder educational attainment through absenteeism, cognitive impairment, or learning difficulties. This bidirectional interaction can create a vicious cycle, where individuals from disadvantaged backgrounds face compounded barriers to both education and health (Raghupathi & Raghupathi, 2020).

Both the poverty depth index and the percentage of the poor population showed a significant positive correlation with disease prevalence ($\rho = 0.286$; $p\text{-value} = 0.0008$ dan $\rho = 0.264$; $p\text{-value} = 0.002$) in spearman test (Table 1), indicating that higher poverty levels and deeper economic disparities increase the risk of filariasis spread. This finding is consistent with Williams et al. (2023), which demonstrated that poverty strongly influences filariasis incidence by reinforcing structural deprivation in health and environmental aspects.

Areas with higher poverty levels generally had limited access to adequate sanitation, clean water, decent housing, and preventive health services. In many of these communities, participation in mass drug administration (MDA) programs also tends to be lower. Consequently, areas with high poverty levels risk experiencing recurrent transmission cycles, forming a hardbreak endemic poverty-disease cycle (Asiedu et al., 2021; Bagonza et al., 2025; Tan, 2003; Krentel et al., 2020; Wharton-Smith et al., 2019).

Interestingly, both the poverty depth index and the percentage of the poor population lost their statistical significance in the multivariate regression model (Table 2), despite showing significant associations in the bivariate analysis. This shift suggests that the apparent relationship between poverty and filariasis is likely mediated or even fully accounted for by other variables in the model, particularly population growth and mean years of schooling. In other words, poverty may influence filariasis risk indirectly through its effects on demographic pressures and educational attainment rather than exerting an independent effect.

Importantly, the persistence of mean years of schooling as a significant predictor, while poverty indicators and population density became non-significant, suggests that education captures deeper and more enduring dimensions of socioeconomic advantage that are not fully reflected in income based measures. In many contexts, education functions as a proxy for long term capacity, empowerment, informed decision making, and stable participation in public health interventions (Cowell, 2006; El Tantawi et al., 2022; Goczek et al., 2021; Tsou, 2017). Thus, its sustained effect in the multivariate model underscores its role as a structural determinant of filariasis vulnerability, operating beyond immediate economic conditions and shaping preventive behaviors, health literacy, and engagement with elimination programs.

Access to proper sanitation and clean water were not significantly associated with chronic filariasis prevalence in either the bivariate analysis (sanitation: $\rho = -0.072$, $p\text{-value} = 0.405$; clean water: $\rho = -0.127$, $p\text{-value} = 0.142$) or the multivariate regression model (sanitation: $p = 0.62$; clean water: $p\text{-value} = 0.97$). Nevertheless, the negative direction of association observed in the bivariate results suggests a general tendency in which better sanitation and water access may contribute to reduced disease burden, consistent with the established ecology of filariasis transmission.

Areas with poor sanitation conditions, such as the presence of open drains or stagnant wastewater, become ideal habitats for *Culex*, *Anopheles*, and *Mansonia* mosquitoes to breed, thereby increasing the risk of transmission of *Wuchereria bancrofti* and *Brugia malayi*

(Akogun et al., 2025). Conversely, greater access to proper sanitation, such as using covered latrines, proper waste disposal systems, and properly managed drainage, can significantly reduce mosquito populations and reduce contact between humans and vectors. Furthermore, the availability of adequate clean water reduces the practice of storing water in open containers, which commonly become breeding grounds for mosquitoes. Access to clean water is also associated with improved personal hygiene and the prevention of open wounds that can exacerbate chronic filariasis symptoms. Therefore, better sanitation and clean water conditions reduce the overall chance of filariasis transmission (Ojo-Akosile et al., 2025).

Although healthcare services are a primary pillar of NTD elimination, the Health Worker Ratio (per 10k population) was also found to be statistically insignificant in both the bivariate ($\rho = -0.075$; $p\text{-value} = 0.389$) and multivariate ($\beta = 0.007$; $p\text{-value} = 0.746$) analyses. This lack of an independent effect explicitly suggests that the *quantity* of human resources in the health sector does not automatically correlate with a reduction in filariasis prevalence.

This result indicates that high disease prevalence is driven less by the mere quantity of health personnel and more by challenges in community-level engagement. In areas marked by rapid population growth or low education levels, formal health workers often struggle to achieve high treatment coverage and sustain community adherence. This difficulty stems primarily from limited local trust, inconsistent participation, and weak behavioral compliance toward public health initiatives like MDA, rather than a lack of healthcare infrastructure (Mahmoodi et al., 2023; Sangare et al., 2025). Furthermore, in many endemic districts, the success of health interventions depends on the extent to which local communities perceive such programs as relevant to their everyday needs; when initiatives are viewed as externally imposed, participation inevitably declines.

A robust strategy to address these implementation challenges is the adoption of a community-based implementation (CBI) framework. CBI represents a paradigm shift from a top-down to a bottom-up model of disease control. Within this framework, primary care providers and community health nurses must transition from traditional, facility-bound clinical roles to functioning as facilitators, educators, and community advocates. This collaborative model leverages the intimate local knowledge possessed by community members regarding social norms and geographical barriers, allowing interventions to be tailored to local needs (Corley et al., 2016; Krentel et al., 2020; Mahmoodi et al., 2023). By fostering this participatory framework, CBI empowers local actors to overcome compliance issues and ensures the sustainability of elimination efforts despite resource constraints or high population mobility (Murphy, 2014; Awasthi et al., 2024; Prat et al., 2023).

Ultimately, the transition toward CBI addresses the structural determinants identified in this study. By prioritizing community-led interventions, primary healthcare teams can more effectively translate educational improvements and infrastructure access into concrete health outcomes. This aligns with the socio-environmental approach to public health, which emphasizes that structural determinants—such as education and basic infrastructure—are most effective when integrated into community-driven health programs (Martin et al., 2024).

3.3 Study limitations and recommendations for future research

This study makes an important contribution to identifying the socio-economic determinants of filariasis in West Java. However, the authors acknowledge several key limitations that constrain the generalizability and interpretation of the results. First, the analytical model does not incorporate ecological and climatic factors, such as daily temperature, rainfall, micro-humidity, specific land use, or mosquito habitat, which are direct determinants of the filariasis vector life cycle. As a result, differences in prevalence between districts (e.g., Sukabumi versus Cimahi) cannot be fully interpreted through socioeconomic factors alone. In some areas, a prevalence value of zero may reflect environmental unsuitability for *Culex* breeding rather than true elimination or effective

program performance. Second, all socio-economic data the authors used were aggregated datasets obtained through open-access databases, rather than directly obtained from each district/city in detail. Using data measured at this broad administrative level may obscure localized variations and necessitates cautious interpretation. The authors also did not include specific operational datasets on the filariasis elimination program, such as detailed annual Mass Drug Administration (MDA) coverage in each region, the quality of the vector control program, and the effectiveness of active surveillance. Therefore, the relationships found with socio-economic variables should be interpreted with caution, as their effects are likely largely mediated by the unmeasured intensity and quality of program implementation.

Third, although the study employed descriptive spatial visualization, it did not assess spatial dependence using inferential spatial statistics such as Moran's I or Local Indicators of Spatial Association (LISA). As a result, the study cannot determine whether high-prevalence districts form statistically meaningful spatial clusters or whether observed geographical patterns arise from random variation. Accordingly, all spatial interpretations should be considered descriptive rather than inferential. For future research, authors recommend the use of higher resolution environmental and climate data like satellite data or local weather stations, the adoption of spatial or geostatistical models to more accurately understand filariasis transmission pathways, and the implementation of mixed methods studies that integrate prevalence data with qualitative data on community adherence to MDA and the direct use of program operational data.

4. Conclusions

The findings reveal a significant and persistent spatial disparity in chronic filariasis across West Java, marked by a clear contrast between high-burden hotspots and the majority of nearly case-free urban areas. Multivariate analysis confirms that population growth is the strongest independent predictor of disease prevalence, suggesting that rapid urbanization and the resulting intensification of human–vector contact are the primary drivers of transmission. Conversely, mean years of schooling emerged as a critical protective factor, underscoring the necessity of improved education and health literacy in breaking the cycle of endemicity.

The results of this study further suggest that filariasis elimination strategies must move beyond mass drug administration alone and address the broader structural determinants of health that sustain transmission. Specifically, long-term elimination efforts should integrate public health policy with spatial and demographic planning to manage rapid and unregulated population growth. To effectively implement these strategies at the grassroots level, practical implications for healthcare systems must be expanded through a Community-Based Implementation (CBI) framework. This approach requires primary healthcare teams and community health nurses to transition from executing uniform, facility-bound campaigns to serving as active facilitators of tailored, localized interventions. By shifting the focus toward community empowerment, participation, and social responsiveness, this framework offers a sustainable path forward to overcome the socioeconomic barriers that have historically sustained filariasis transmission in West Java.

Acknowledgement

The authors would like to express sincere gratitude to Statistics Indonesia (Badan Pusat Statistik – BPS) and Open Data Jabar for providing access to the provincial and district/city level datasets that made this analysis possible.

Author Contribution

R.D.A., Conceptualization, Methodology, Software, Validation, Formal Analysis, Investigation, Data Curation, Writing, Original Draft Preparation, Visualization. Y.D.K., Review & Editing, Validation, Supervision.

Funding

This research received no external funding.

Ethical Review Board Statement

Not available. The study did not involve human participants or animals, and all data analyzed were obtained from publicly available secondary sources provided by Statistics Indonesia (BPS), Open Data Jabar, and the Ministry of Health. Therefore, ethical review and approval were not required for this study.

Informed Consent Statement

Not available. The study used aggregated, publicly available data without any individual or personally identifiable information.

Data Availability Statement

The datasets analyzed in this study are publicly available from Statistics Indonesia (Badan Pusat Statistik – BPS) and Open Data Jabar repositories at <https://bps.go.id> and <https://opendata.jabarprov.go.id>.

Conflicts of Interest

The authors declare no conflict of interest.

Declaration of Generative AI Use

During the preparation of this work, the author used ChatGPT (OpenAI) to assist in translation, language polishing, and paraphrasing of selected sections, as well as drafting captions and section headings. After using this tool, the author reviewed and edited the content as needed and took full responsibility for the content of the publication. No generative AI was used to create or alter the underlying data, statistical results, or scientific conclusions.

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References

- Abou-El-Naga, I. F. (2015). Demographic, socioeconomic and environmental changes affecting circulation of neglected tropical diseases in Egypt. *Asian Pacific Journal of Tropical Medicine*, 8(11), 881–888. <https://doi.org/10.1016/j.apitm.2015.10.015>
- Ahumada, J. A., Laoointe, D., & Samuel, M. D. (2004). Modeling the population dynamics of *Culex quinquefasciatus* (Diptera: Culicidae), along an elevational gradient in Hawaii. *Journal of Medical Entomology*, 41(6), 1157–1170. <https://doi.org/10.1603/0022-2585-41.6.1157>
- Aisyah, D. N., Kozlakidis, Z., Diva, H., Trimizi, S. N., Sianipar, L. R., Wijayanti, E., Avicena, A. M., & Adisasmito, W. (2022). The spatial-temporal distribution of chronic lymphatic filariasis in Indonesia: A 18-year registry-based analysis. *Microbiology Research*, 13(4), 681–690. <https://doi.org/10.3390/microbiolres13040049>

- Akogun, O. B., Adewale, B., Mogaji, H. O., Dawodu, R., Bankole, M., Adewlae, A., Abdus-Salam, I. A., Ononogbo, I., Olamiju, F. O., Tehemen, J., & Isiyaku, S. (2025). Confirmatory mapping for lymphatic filariasis a decade after baseline endemicity assessment in highly urbanized settings of Lagos, Nigeria. *International Journal of Infectious Diseases*, 159, 108014. <https://doi.org/10.1016/j.ijid.2025.108014>
- Alomar, A. A. (2025). Effects of temperature and *Culex velezensis* on the development, longevity, and reproduction of *Culex quinquefasciatus*. *Biology*, 14(4), 357. <https://doi.org/10.3390/biology14040357>
- Annashr, N. N., Amalia, I. S., & Dinh, H. T. P. (2021). Low knowledge and lack of awareness regarding the mass drug administration health promotion as the determinant factors in non-compliance to the mass drug administration health program. *Kesmas: National Public Health Journal*, 16(1). <https://doi.org/10.21109/kesmas.v16i1.3271>
- Asiedu, S. O., Kwarteng, A., Amewu, E. K. A., Kini, P., Aglomasa, B. C., & Forkuor, J. B. (2021). Financial burden impact quality of life among lymphatic Filariasis patients. *BMC Public Health*, 21(1), 174. <https://doi.org/10.1186/s12889-021-10170-8>
- Awasthi, K. R., Jancey J., Clements, A. C. A., Rai, R., & Leavy, J. E. (2024). Community engagement approaches for malaria prevention, control and elimination: A scoping review. *BMJ Open*, 14(2), e081982. <https://doi.org/10.1136/bmjopen-2023-081982>
- Bagonza, A., Gibson, L., Kabiri, L., Bezalel, C., Narahari, S. R. B., Franks, P. J., Musoke, D., & Moffatt, C. (2025). Exploring barriers to accessing treatment for Lymphatic Filariasis through a socio-ecological lens in Buvuma and Napak districts, Uganda. *PLOS Neglected Tropical Diseases*, 19(1), e0012747. <https://doi.org/10.1371/journal.pntd.0012747>
- Bhuvaneswari, A., Shriram, A. N., Raju, K. H. K., & Kumar, A. (2023). Mosquitoes, lymphatic filariasis, and public health: A systematic review of anopheles and aedes surveillance strategies. *Pathogens (Basel, Switzerland)*, 12(12), 1406. <https://doi.org/10.3390/pathogens12121406>
- Branda, F., Ali, A. Y., Ceccarelli, G., Albanese, M., Binetti, E., Giovanetti, M., Ciccozzi, M., & Scarpa, F. (2024). Assessing the burden of neglected tropical diseases in low-income communities: Challenges and solutions. *Viruses*, 17(1), 29. <https://doi.org/10.3390/v17010029>
- Butala, C. B., Cave, R. N. R., Fyfe, J., Coleman, P. G., Yang, G.-J., & Welburn, S. C. (2024). Impact of COVID-19 on the neglected tropical diseases: A scoping review. *Infectious Diseases of Poverty*, 13(1), 55. <https://doi.org/10.1186/s40249-024-01223-2>
- Ca, J., Kumar P, V. B., Kandi, V., N, G., K, S., Dharshini, D., Batchu, S. V. C., & Bhanu, P. (2024). Neglected tropical diseases: A comprehensive review. *Cureus*, 16(2), e53933. <https://doi.org/10.7759/cureus.53933>
- Chaturvedi, R., & Sharma, A. (2025). Key facets for the elimination of vector-borne diseases filariasis, leishmaniasis, and malaria. *ACS Infectious Diseases*, 11(2), 287–304. <https://doi.org/10.1021/acsinfecdis.4c00431>
- Chiphwanya, J., Mkwanda, S., Kabuluzi, S., Mzilahowa, T., Ngwira, B., Matipula, D. E., Chaponda, L., Ndhlova, P., Katchika, P., Mahebere Chirambo, C., Moses, P., Kumala, J., Chiumia, M., Barrett, C., Betts, H., Fahy, J., Rebollo Polo, M., Reimer, L., Stanton, M. C., ... Kelly-Hope, L. A. (2024). Elimination of lymphatic filariasis as a public health problem in Malawi. *PLOS Neglected Tropical Diseases*, 18(2), e0011957. <https://doi.org/10.1371/journal.pntd.0011957>
- Corley, A. G., Thornton, C. P., & Glass, N. E. (2016). The role of nurses and community health workers in confronting neglected tropical diseases in sub-Saharan Africa: A systematic review. *PLoS neglected tropical diseases*, 10(9), e0004914. <https://doi.org/10.1371/journal.pntd.0004914>
- Cowell, A. J. (2006). The relationship between education and health behavior: Some empirical evidence. *Health Economics*, 15(2), 125–146. <https://doi.org/10.1002/hec.1019>
- Douglass, J. (2025). Eliminating lymphatic filariasis as a public health problem. In *Applied aymphology: Basics| Daily practice| Perspectives* (pp. 477-493). Cham: Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-77734-9_25

- Dowling, Z., Armbruster, P., LaDeau, S. L., DeCotiis, M., Mottley, J., & Leisnham, P. T. (2013). Linking mosquito infestation to resident socioeconomic status, knowledge, and source reduction practices in suburban Washington, DC. *Ecohealth*, 10(1), 36-47. <https://doi.org/10.1007/s10393-013-0818-6>
- El Tantawi, M., Aly, N. M., & Folayan, M. O. (2022). Unemployment and expenditure on health and education as mediators of the association between toothbrushing and global income inequalities. *BMC Oral Health*, 22(1), 539. <https://doi.org/10.1186/s12903-022-02570-y>
- Ferreira, L. L. G., De Moraes, J., & Andricopulo, A. D. (2022). Approaches to advance drug discovery for neglected tropical diseases. *Drug Discovery Today*, 27(8), 2278-2287. <https://doi.org/10.1016/j.drudis.2022.04.004>
- Goczek, Ł., Witkowska, E., & Witkowski, B. (2021). How does education quality affect economic growth? *Sustainability*, 13(11), 6437. <https://doi.org/10.3390/su13116437>
- Hongoh, V., Berrang-Ford, L., Scott, M. E., & Lindsay, L. R. (2012). Expanding geographical distribution of the mosquito, *Culex pipiens*, in Canada under climate change. *Applied Geography*, 33, 53-62. <https://doi.org/10.1016/j.apgeog.2011.05.015>
- Houweling, T. A. J., Karim-Kos, H. E., Kulik, M. C., Stolk, W. A., Haagsma, J. A., Lenk, E. J., Richardus, J. H., & De Vlas, S. J. (2016). Socioeconomic inequalities in neglected tropical diseases: A systematic review. *PLOS Neglected Tropical Diseases*, 10(5), e0004546. <https://doi.org/10.1371/journal.pntd.0004546>
- Jaworski, A., Craig, A. T., Dyer, C. E. F., Goncalves, J., Neuendorf, N., Newland, J., Kelly-Hanku, A., Pomat, W., MacLaren, D., & Vaz Nery, S. (2024). Understanding how neglected tropical diseases programs in five Asia-Pacific countries adjusted to the COVID-19 pandemic: A qualitative study. *PLOS Neglected Tropical Diseases*, 18(5), e0012221. <https://doi.org/10.1371/journal.pntd.0012221>
- Khalid, A., Abdelgadir, M. A., Ashmaig, A., Ibrahim, A. M., Ahmed, A. M., & Adam, I. (2012). *Schistosoma mansoni* infection among prenatal attendees at a secondary-care hospital in central Sudan. *International Journal of Gynecology & Obstetrics*, 116(1), 10-12. <https://doi.org/10.1016/j.ijgo.2011.08.018>
- Kitole, F. A., Ojo, T. O., Emenike, C. U., Khumalo, N. Z., Elhindi, K. M., & Kassem, H. S. (2024). The impact of poor waste management on public health initiatives in shanty towns in Tanzania. *Sustainability*, 16(24), 10873. <https://doi.org/10.3390/su162410873>
- Krentel, A., Gyapong, M., McFarland, D. A., Ogundahunsi, O., Titaley, C. R., & Addiss, D. G. (2020). Keeping communities at the centre of efforts to eliminate lymphatic filariasis: Learning from the past to reach a future free of lymphatic filariasis. *International Health*, 13(Supplement_1), S55-S59. <https://doi.org/10.1093/inthealth/ihaa086>
- Kwarteng, E. V. S., Andam-Akorful, S. A., Kwarteng, A., Asare, D.-C. B., Quaye-Ballard, J. A., Osei, F. B., & Duker, A. A. (2021). Spatial variation in lymphatic filariasis risk factors of hotspot zones in Ghana. *BMC Public Health*, 21(1), 230. <https://doi.org/10.1186/s12889-021-10234-9>
- Lupi, V., & Marsiglio, S. (2021). Population growth and climate change: A dynamic integrated climate-economy-demography model. *Ecological Economics*, 184, 107011. <https://doi.org/10.1016/j.ecolecon.2021.107011>
- Magalhães, A. R., Codeço, C. T., Svenning, J.-C., Escobar, L. E., Van De Vuurst, P., & Gonçalves-Souza, T. (2023). Neglected tropical diseases risk correlates with poverty and early ecosystem destruction. *Infectious Diseases of Poverty*, 12(1), 32. <https://doi.org/10.1186/s40249-023-01084-1>
- Mahmoodi, H., Bolbanabad, A. M., Shaghaghi, A., Zokaie, M., Gheshlagh, R. G., & Afkhamzadeh, A. (2023). Barriers to implementing health programs based on community participation: The Q method derived perspectives of healthcare professional. *BMC Public Health*, 23(1), 2019. <https://doi.org/10.1186/s12889-023-16961-5>
- Martin, B. M., Cadavid Restrepo, A., Mayfield, H. J., & Lau, C. L. (2024). Towards global elimination of lymphatic filariasis: A systematic review of the application of spatial epidemiological methods to enhance surveillance and support elimination

- programmes. *BMJ Public Health*, 2(1), e000534. <https://doi.org/10.1136/bmjph-2023-000534>
- Ministry of Health. (2023a). *Laporan kinerja kementerian kesehatan tahun 2023*. Kementerian Kesehatan Republik Indonesia.
- Ministry of Health. (2023b). *Profil kesehatan Indonesia 2023*. Kementerian Kesehatan Republik Indonesia.
- Moser, S. K., Barnard, M., Frantz, R. M., Spencer, J. A., Rodarte, K. A., Crooker, I. K., Bartlow, A. W., Romero-Severson, E., & Manore, C. A. (2023). Scoping review of Culex mosquito life history trait heterogeneity in response to temperature. *Parasites & Vectors*, 16(1), 200. <https://doi.org/10.1186/s13071-023-05792-3>
- Murphy, J. W. (2014). *Community-based interventions: Philosophy and action*. Springer New York. <https://doi.org/10.1007/978-1-4899-8020-5>
- Ojo-Akosile, T., Uwah, E. A., Mufungizi, I., Aborode, A. T., Nkundakozera, M., Rusho, M. A., Bakare-Abidola, T., Izinyon, O., Tochukwu, A. M., Onifade, I. A., Nwosu, K. O. S., & Akilimali, A. (2025). Water, sanitation and hygiene and neglected tropical diseases in the Democratic Republic of Congo: A narrative review and policy perspective. *Discover Social Science and Health*, 5(1), 147. <https://doi.org/10.1007/s44155-025-00306-1>
- Prat, J. G. I., Alguacil, H. M., Saco, S. P., Essadek, H. O., Garcia, J. M. I., Llena, O. C. I., & Peña, J. M. (2023). Implementation of a community-based public model for the prevention and control of communicable diseases in migrant communities in Catalonia. *Tropical Medicine and Infectious Disease*, 8(9), 446. <https://doi.org/10.3390/tropicalmed8090446>
- Ragab, S. H., Alkhaibari, A. M., Alharbi, J., Areshi, S. M., Mashlawi, A. M., Embaby, D. M., Tyshenko, M. G., Selim, T. A., & Kamel, M. (2024). Impact of climate change on culex pipiens mosquito distribution in the United States. *Sustainability*, 17(1), 102. <https://doi.org/10.3390/su17010102>
- Raghupathi, V., & Raghupathi, W. (2020). The influence of education on health: An empirical assessment of OECD countries for the period 1995–2015. *Archives of Public Health*, 78(1), 20. <https://doi.org/10.1186/s13690-020-00402-5>
- Roswati, Santi, Syafii, A., Mahendra, E., & Tosepu, R. (2021, April). A systematic literature (impact of climate change on filariasis). In *IOP Conference Series: Earth and Environmental Science*, 755(1), 012083. IOP Publishing. <https://doi.org/10.1088/1755-1315/755/1/012083>
- Sangare, M., Coulibaly, Y. I., Diabate, A. F., Dolo, H., Koureichi, M. M., Diarra, D., Duguay, C., Stephens, M., Diakité, M., Kulkarni, M. A., Nutman, T. B., & Krentel, A. (2025). Factors associated with low coverage in mass drug administration for schistosomiasis in mobile populations in Mali: A cross-sectional study. *BMC Infectious Diseases*, 25(1), 1240. <https://doi.org/10.1186/s12879-025-11626-7>
- Schudde, L., & Bernell, K. (2019). Educational attainment and nonwage labor market returns in the United States. *AERA Open*, 5(3). <https://doi.org/10.1177/2332858419874056>
- Sharma, S., Singh, A. K., Singh, T., Kumar, S., & Singh, A. (2025). *Field-based assessment of lymphatic filariasis transmission dynamics and intervention outcomes in Varanasi District*. Public and Global Health. <https://doi.org/10.1101/2025.07.14.25331498>
- Shechtman, O. (2013). The coefficient of variation as an index of measurement reliability. In S. A. R. Doi & G. M. Williams (Eds.), *Methods of Clinical Epidemiology* (pp. 39–49). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-37131-8_4
- Sripa, B., Leonardo, L., Hong, S.-J., Ito, A., & Brattig, N. W. (2022). Status and perspective of asian neglected tropical diseases. *Acta Tropica*, 225, 106212. <https://doi.org/10.1016/j.actatropica.2021.106212>
- Tan, J. Z. G. (2003). The elimination of lymphatic filariasis: A strategy for poverty alleviation and sustainable development – perspectives from the Philippines. *Filaria Journal*, 2(1), 12. <https://doi.org/10.1186/1475-2883-2-12>
- Tripathi, B., Roy, N., & Dhingra, N. (2022). Introduction of triple-drug therapy for accelerating lymphatic filariasis elimination in india: lessons learned. *The American Journal of Tropical Medicine and Hygiene*. <https://doi.org/10.4269/ajtmh.21-0964>

- Tsou, M. T. (2017). Association of education, health behaviors, concerns, and knowledge with metabolic syndrome among urban elderly in one medical center in Taiwan. *International Journal of Gerontology*, 11(3), 138–143. <https://doi.org/10.1016/j.ijge.2016.09.006>
- Ugbomoiko, U. S., Dalumo, V., Ofoezie, I. E., & Obiezue, R. N. N. (2009). Socio-environmental factors and ascariasis infection among school-aged children in Ilobu, Osun State, Nigeria. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 103(3), 223–228. <https://doi.org/10.1016/j.trstmh.2008.12.014>
- Vasconez-Gonzalez, J., Miño, C., Noboa, M. D. L., Tello-De-la-Torre, A., Izquierdo-Condoy, J. S., & Ortiz-Prado, E. (2025). The psychosocial and emotional burden of lymphatic filariasis: A systematic review. *PLOS Neglected Tropical Diseases*, 19(5), e0013073. <https://doi.org/10.1371/journal.pntd.0013073>
- Wharton-Smith, A., Rassi, C., Batisso, E., Ortu, G., King, R., Endriyas, M., Counihan, H., Hamade, P., & Getachew, D. (2019). Gender-related factors affecting health seeking for neglected tropical diseases: Findings from a qualitative study in Ethiopia. *PLOS Neglected Tropical Diseases*, 13(12), e0007840. <https://doi.org/10.1371/journal.pntd.0007840>
- WHO. (2022). *Impact of COVID-19 on NTD programmes (sixteenth meeting of the strategic and technical advisory group for neglected tropical diseases, pp. 15–26)*. World Health Organization. <http://www.jstor.org/stable/resrep56750.5>
- WHO. (2023). *Global partners pledge US\$ 777 million to combat neglected tropical diseases*. World Health Organization Website. <https://www.who.int/news/item/04-12-2023-global-partners-pledge-usd777-million-to-combat-neglected-tropical-diseases>
- Williams, T., Karim, M. J., Uddin, S., Jahan, S., Asm, S. M., Forbes, S. P., Hooper, A., Taylor, M. J., & Kelly-Hope, L. A. (2023). Socio-economic and environmental factors associated with high lymphatic filariasis morbidity prevalence distribution in Bangladesh. *PLOS Neglected Tropical Diseases*, 17(7), e0011457. <https://doi.org/10.1371/journal.pntd.0011457>
- Zajacova, A., & Lawrence, E. M. (2018). The relationship between education and health: reducing disparities through a contextual approach. *Annual Review of Public Health*, 39(1), 273–289. <https://doi.org/10.1146/annurev-publhealth-031816-044628>
- Zhao, H., Xu, T., & Shen, H. (2025). Global, regional, and national disability-adjusted life years and prevalence of lymphatic filariasis from 1990 to 2021: A trend and health inequality analysis based on the global burden of disease study 2021. *PLOS Neglected Tropical Diseases*, 19(4), e0013017. <https://doi.org/10.1371/journal.pntd.0013017>

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